QUIET ASPHALT CONCRETE PAVEMENT

328.1 GENERAL: Quiet asphalt concrete (QAC) pavement shall consist of proportioning, mixing in a central plant, aggregate, bituminous materials, admixtures as required, transporting, placing, and compaction, in substantial compliance with this specification, at the areas/volumes and dimensions specified in the CONTRACT plans and specifications. The CONTRACTOR shall be solely responsible for the QAC materials and construction. A job mix formula used for QAC shall be certified in accordance with the requirements of Section 13 of these specifications. Each job mix formula submitted and authorized for use under this specification shall be identified by a number, unique to that job mix formula and production plant. If either a change in material(s) or material supplier(s) from that specified in the job mix formula occurs during a project, authorized use of the job mix formula on the project may be canceled as directed by the ENGINEER. A job mix formula shall not be used on a project without written approval of the ENGINEER. A job mix formula, upon request by a supplier, may be authorized by the Public Works Department Construction Division for use on City and City related projects for a period of 14 months, from the date of sampling of aggregates used in the job mix formula.

328.2 REFERENCES:

328.2.1 American Society For Testing and Materials (ASTM), (Latest Edition):

C88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

C117 Method for Material Finer Than 0.75 um (No.200) Sieve In Mineral Aggregates by Washing

C131 Test Method for Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in a Los Angeles Machine

C136 Method for Sieve Analysis of Fine and Coarse Aggregate

D242 Specifications for Mineral Filler for Bituminous Paving Mixtures

D692 Specification for Coarse Aggregate for Bituminous Paving Mixtures

D979 Methods of Sampling Bituminous Paving Mixtures

D995 Specification for Mixing Plants for Hot-Mixed, Hot Laid Bituminous Paving Mixtures

D1073 Specification for Fine Aggregate for Bituminous Paving Mixtures

D1074 Test Method for Compressive Strength of Bituminous Mixtures

D1559 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures

D2172 Quantitative Extraction of Bitumen From Bituminous Paving Mixtures

D2493 Viscosity-Temperature Chart for Asphalts

D2726 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

D2851 Test for Determining the Percentage of Fractured Particles in Coarse Aggregate

D2950 Density of Bituminous Concrete in Place by Nuclear Methods

D3203 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

D3515 Standard Specification for Hot Mixed, Hot-Laid Bituminous Paving Mixtures

D4125 Asphalt Content of Bituminous Mixtures by the Nuclear Method

D4791 Test for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

328.2.2 American Association of State Highway and Transportation Officials (AASHTO) (Latest Edition):

MP2 Specification for Superpave™ Volumetric Mix Design

PP-28 Superpave™ Volumetric Design for HMA

TP 4 Preparation of Compacted Specimens of Modified and Unmodified Hot Mix Asphalt by Means of SHRP Gyratory Compactor

PP 2 Short and Long-term Aging of Bituminous Mixes

T53 Quantitative Analysis of Bitumen From Bituminous Paving Mixtures. Ignition Oven Method

T245 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

T283 Resistance of Bituminous Mixture To Moisture Induced Damage

T304 Uncompacted Void Content of Fine Aggregate

328.2.3 This publication:

SECTION 13 WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTIONS, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

SECTION 112 ASPHALT BINDER

SECTION 113 EMULSIFIED ASPHALTS

SECTION 118 HYDRATED LIME

SECTION 336 ASPHALT CONCRETE PAVEMENT

328.3 MATERIALS:

328.3.1   The asphalt binder shall be performance grade binder PG76-28 and comply with the requirements of Section 112.

328.3.2   Aggregates shall be crushed stone, crushed gravel, and natural or manufactured sand. Coarse aggregate(s) shall comply with the requirements of ASTM D692 and this specification. Fine aggregate(s) shall comply with the requirements of ASTM D1073 and this specification. Aggregates shall be certified to comply with the requirements of this specification and authorized for use by The ENGINEER before the materials may be incorporated into the construction. Prior to delivery of the aggregates or material containing the aggregates, The CONTRACTOR may be required to furnish samples of the aggregates to The ENGINEER for testing. Daily production aggregates gradations shall be submitted to the ENGINEER, upon request.

328.3.3   Mineral filler shall comply with the requirements of ASTM D242, Mineral Filler for Bituminous Paving Mixtures and as specified herein. Mineral filler shall be certified to comply with the requirements of this Specification and approved for use by the ENGINEER before the materials may be incorporated in the construction. Prior to either delivery of the mineral filler or material containing the mineral filler, The CONTRACTOR may be required to furnish samples of the mineral filler to The ENGINEER for testing.

328.3.4   Quiet asphalt concrete shall comply with the minimum requirements of TABLE 328.C. Moisture susceptibility, % retained strength at 22% air voids, AASHTO T283, with freeze cycle. Admixtures to reduce moisture susceptibility in a quiet asphalt concrete mix shall be either hydrated lime, portland cement, liquid admixture, or a modified asphalt binder as directed by the ENGINEER.

328.4 PROPORTIONING

328.4.1   The CONTRACTOR shall be solely responsible for the quiet asphalt concrete job mix formula (jmf) proportions and quiet asphalt concrete either batched at and/or delivered to the site. Quiet asphalt concrete shall be proportioned in accordance with the requirements of this Specification.

328.4.2   Quiet asphalt concrete material shall be proportioned to comply with the requirements of TABLE 328.A, 328.B, and 328.C of this specification, AASHTO MP2, Specification for Superpave™ Volumetric Mix Design, and PP-28, Superpave™ Volumetric Design for HMA. Quiet asphalt concrete job mix formula shall be designed under the direct supervision of a New Mexico Registered Professional Engineer who has completed a certified SUPERPAVE Mixture Design & Analysis" Short Course.

328.4.3   Quiet asphalt concrete design and analysis shall be performed in a laboratory accredited in accordance with the requirements of the New Mexico State Highway and Transportation Department "Procedure for Approval of Testing Laboratories to Perform Inspection, Testing, and Mix Design Services", April 13, 1998 Edition, under the direct supervision of a New Mexico Registered Professional Engineer.

328.4.4   The testing equipment used in the performance of design development testing shall be (1) certified to comply with the specifications, and (2) calibrated annually with standards traceable to the National Bureau of Standards, as specified by the manufacturer. Certificates of calibration and equipment standards shall be maintained at the laboratory for review and shall be submitted to the ENGINEER upon request.

328.4.5   Aggregates and mineral anti strip admixture, if required, shall be proportioned to provide a combined aggregate gradation that complies with the requirements specified in Tables 328.A and 328.B. The target gradation shall have a similar shape characteristic gradation curve as the specification limits when graphically plotted on a standard "0.45 POWER" gradation chart. The gradation shall be reported to the nearest whole per cent for material passing sieves above the 0.075 mm (no. 200) sieve, and to the nearest 0.1 per cent for material passing the 0.075 mm (no. 200) sieve. The theoretical maximum density gradation curve shall be the curve represented by a straight line drawn from the intersection of the ordinate and abscissa of the graph to the one hundred percent passing point for the nominal maximum size aggregate.

328.4.6   The asphalt binder content shall be proportioned to comply with the requirements defined in TABLE 328.C. The percentage of binder shall be determined based on laboratory testing complying with the requirements of this specification, submitted by the Contractor, and authorized by the ENGINEER. The percentage asphalt binder production tolerance shall be± 0.3 percent as determined by the tank strap method, and ± 0.5 percent for laboratory quantitative analysis methods.

328.4.7   The materials specified in a job mix formula shall be the same source and type for all quiet asphalt concrete batched, delivered, placed and compacted, under the identification code defined for the authorized job mix formula.

TABLE 328.A - GRADATION

Sieve Designation		Percent by Weight Passing Sieve		[A]
in.	(mm)	Min	Max	%
0.75	(19.00)	100	100	
5/8	(16.00)	92	98	8
½	(12.50)	70	85	8
3/8	(9.50)	40	60	8
no.4	(4.75)	15	25	7
no.16	(2.36)	5	15	5
no.50	(0.30)	3	12	5
no.200	(0.08)	2.0	6.0	2.0

A. Production Tolerance

TABLE 328.B- COMBINED AGGREGATE DESIGN PROPERTIES

CHARACTERISTIC	AGGREGATE TYPE		PROCEDURE
	Coarse	Fine	
1. Coarse aggregate angularity, material > 4.75 mm	95[1] 90[2]		ASTM D 5821
2. Fine aggregate angularity as air voids, %, min	-	45	AASHTO TP 33
3. Flat and elongated particles, 3:1 or greater dimension, material > 4.75 mm, %	20 max		ASTM D 4791
4. Clay content, min %	-	45	ASTM D 2419
5. Deleterious material, max %	1	1	ASTM C 142
6. LA Abrasion, material > 2.36 mm, max loss, %	40	40	ASTM C 131
7. Soundness, max loss after 5 cycles, %	15	15	ASTM C 88

[1] coarse aggregate has one or more fractured faces
[2] coarse aggregate has two or more fractured faces

TABLE 328.C - QUIET ASPHALT CONCRETE DESIGN SPECIFICATIONS

Characteristics @ Nd		Specification
A. Binder Content, PG76-28, %		5.5 to 6.5
B. Air voids, %		19.5 - 20.5
C. Voids filled with asphalt, VFA, minimum		35 - 45
D. Gyratory Compactive Effort		
Compaction, % [1]	Gyrations	Specification
< 75	Ni (initial)	7
78 - 82	Nd (design)	95
< 85	Nm (max)	150
E. Moisture susceptibility, min % retained strength @ 22 % air voids, AASHTO T283		80

[1] As % of maximum theoretical specific gravity / density, Gmm.

[2] The bulk specific gravity (Gmb) of a molded briquette at Nm shall be determined based on mass (m) measured to the nearest 0.01g, and the volume (V) calculated to the nearest 0.1 cc. The volume shall be calculated based on measurements of the diameter and height of the briquette. The height (h) and diameter (d) of a briquette shall be measured to the nearest 0.001 in. The volume shall be calculated from the average of at least four (4) measurements of the height and diameter, PI=3.1415927, 1 in=25.4 mm, and the formula $V=0.25 PI d^2 h$. The bulk specific gravity shall be calculated as the mass divided by the volume, Gmb@Nm=m/V, reported to 0.001. For English units, Gmb'=Gmb@Nm x 62.245 pcf.

328.5   SUBMITTALS:

328.5.1   A job mix formula submittal shall include but
not be limited to the information specified in Table 328.D.

TABLE 328.D - SUBMITTAL INFORMATION

I.   Identification

   A. Asphalt concrete supplier

   B. Laboratory that performed design/development tests

   C. Date of Submittal

   D. Unique mix code identification number

   E. Aggregate sample date

II.   Job Mix Formula (jmf)

   A. City type/application of asphalt concrete

   B. Component material target proportions to include combined aggregate gradation and asphalt content, specifications, and production tolerances

   C. 0.45 power gradation plot of combined aggregate gradation with specification and production limits

   D. Temperature viscosity relationship of binder

   E. Recommended mixing, compaction, and release to traffic maximum temperatures.

   F. Tabulation of job mix formula performance characteristics defined in TABLE, at the proposed design proportions, with reference specification limits and production limits (if specified), maximum theoretical specific gravity/density (as pcf), and bulk specific gravity/density (pcf).

   G. Reference daily production gradation, see Section 116

III.   Certifications of Compliance

   A. Compliance of job mix formula by NM Registered Professional Engineer in direct charge of design/development;

   B. Design Laboratory Certification.

   C. Component materials testing and certification by supplier/manufacturer with supporting test data for materials used in design development

   D. Certification and laboratory test results of asphalt binder used in job mix formula design development, see Section 112.

IV.   Design Development (Tables and graphs, with specifications limits of the following:)

   1. Trial Designs: Aggregate gradations, 3 minimum required, and trial asphalt binder content (%)

      a) Table of Aggregate Gradations and 0.45 power plot, with specification limits

      b) Trial design % asphalt content

      c) Trial designs volumetric analysis for each gradation, VMA, Va, VFA, graph not required

      d) Trial designs compaction analysis @ Ni, Nd, and Nm, for each gradation

      e) Dust ratio for each trial design, graph not required.

   2. Job Mix Formula Design, (design development with a minimum of 4 asphalt binder contents required, and the recommended design characteristic bracketed by a minimum of two test points for the design binder content + 0.5%)

      a) Table of design aggregate gradation and 0.45 power plot, with specification limits and production targets

      b) Compaction analysis G_{mb} as % G_{m} at Ni, Nd, and Nm, vs asphalt content (separate graphs for Ni, Nd, and Nm)

      c) Volumetric analysis of VMA, Va, VFA, and dust ratio at design gyration, @Nd, vs % asphalt content

      d) Gyratory compaction tables as height of sample versus gyration, for each asphalt content, Gmb @ NM, and bulk specific gravity/density correction factor(s) (graphs not required)

      e) Maximum theoretical specific gravity/density (as pcf), G_{mm}, vs %asphalt content

      f) Corrected bulk specific gravity/density (as pcf), G_{mb}, vs % asphalt content

      e) dust ratio vs.% asphalt content

      f) Recommended gyratory sample mass(g) for 115 mm sample height at Nm

   C. Ignition Correction Factor: Correction for material losses during asphalt content ignition oven analysis

      The correction factor shall be determined as the average value for three samples, design % asphalt content, design - 1.0%, and design +1.0%, developed in an ignition oven complying with the requirements of AASHTO T53, Method A.

328.5.2   A job mix formula submittal shall be accepted or rejected within ten (10) working days of receipt by the ENGINEER. A submittal shall be rejected if it does not include the specified information.

328.6   CONSTRUCTION METHOD

328.6.1   Quiet Asphalt Concrete shall be batched in accordance with the requirements of ASTM D3515, the requirements of this Specification, as authorized by the ENGINEER. Batching facilities shall comply with the requirements of ASTM D995, and this Specification. A batch plant shall be certified annually by a New Mexico Registered Professional Engineer, to comply with the requirements of this Specification and Section 13. Certification shall be completed within 12 months prior to submittal of a job mix formula to be produced at the plant. The batch plant shall be calibrated annually with calibration standards traceable to the National Bureau of Standards. Certificates of calibration and production certifications shall be maintained at the plant for review and shall be submitted to the ENGINEER upon request.

328.6.2   The mineral aggregate mixing temperature shall be not less than nor greater than the mixing temperature range specified in the authorized job mix formula

328.6.3   Asphalt binder mixing shall be not less than nor greater than the mixing temperature range specified in the authorized job mix formula when introduced into the mixture.

328.6.4   Quiet Asphalt Concrete shall be batched and placed at the design proportions specified in the authorized job mix formula within the specified production tolerances for combined aggregate gradation and asphalt binder content. Asphalt concrete placed at a project, sampled and tested in accordance with this specification, shall have a gradation that complies with the authorized design gradation ± the production tolerance(s) specified in the authorized job mix formula. Asphalt concrete placed at a project, sampled and tested in accordance with this specification, shall have an asphalt content that complies with the design asphalt content ± 0.5% (laboratory analysis).

328.7   DELIVERY

328.7.1.1   Quiet Asphalt Concrete shall be delivered in trucks free of fluid leaks. Trucks detected to have leaks shall not be allowed on the project. Subgrade, base course, and asphalt concrete surfaces contaminated by uncontrolled equipment fluids shall be removed and replaced with complying material. Contaminated material shall be disposed of as specified. When hauling time from the mixing plant to the job site exceeds two hours or when

inclement weather prevails, bituminous mixtures shall be covered with tarpaulins while being hauled. The tarpaulins shall completely cover the load and be firmly tied down. Mixtures shall be delivered to site of the work and placed without segregation of the ingredients and within the temperature range specified in the authorized job mix formula. Diesel fuel or other petroleum based solvents shall not be used in the bed of transport vehicles as a release agent to prevent build up of the asphalt material. Material contaminated with diesel fuel or other petroleum based solvents shall be removed and replaced with complying material by the CONTRACTOR, as directed by the ENGINEER, at no cost to the OWNER.

328.7.1.2   The CONTRACTOR shall provide to The ENGINEER with each load of quiet asphalt concrete batched at and/or delivered to the job site, before unloading at the site, a delivery ticket on which is printed, stamped or written, the information defined in Table 329.D. A copy of the ticket shall be available for the ENGINEER and a copy shall be available for quality assurance sample reference. Diesel fuel or other petroleum based solvents shall not be used in the bed of transport vehicles as a release agent to prevent build up of the SUPERPAVE asphalt material. If the use of diesel is detected, the load shall be rejected.

TABLE 328.E – DELIVERY TICKET INFORMATION

Name of Asphalt Concrete Supplier
Date of Delivery
Delivery Ticket Number Contractor
Project Name (optional)
Job Mix Formula Number
Weight of Load (tons)
Time loaded

328.7.1.3   Quiet asphalt concrete shall be delivered to a project at a temperature that allows for placement and start of compaction in the range specified in the authorized job mix formula.

328.7.2   Prior to placing quiet asphalt concrete, all foreign matter shall be swept cleaned from the surface of the existing pavement.

328.7.3   A tack coat shall be applied to provide a uniform and complete coverage, as directed by the ENGINEER. Tack shall consist of either SS-1 or SS1h emulsified asphalt, diluted with an equal volume of water, at the rate of 0.03 to 0.12 gal/yd^2. The exact quantities being determined by the ENGINEER. Tack shall not be puddled.

328.8   PLACEMENT AND COMPACTION:

328.8.1   Quiet Asphalt Concrete may be placed when the

pavement temperature is 60 °F and rising, and the weather is favorable to construction, as authorized by the Engineer. Asphalt concrete may not be placed in either wet weather, or on a wet or damp surface, or on frozen supporting material

328.8.2   In either narrow, or irregular sections, or intersections, or turning radiuses, or turnouts, where it is impractical to spread and finish the base and level the surface mixtures by machine methods, the CONTRACTOR may use placement equipment and/or acceptable hand methods, as authorized by the Engineer.

328.8.3   Quiet asphalt concrete shall be placed in a uniform compactor lift, equal or greater than 1 inch and less than or equal to 1.5 inch, by means of a bituminous paver conforming to the requirements of Section 336.   The temperature of the mixture shall neither less than nor greater than the compaction temperature range specified in the authorized job mix formula after placement on the road, behind the lay down machine.

328.8.4   Compaction shall begin when the quiet asphalt concrete temperature is in the compaction temperature range specified in the authorized job mix formula. Compaction shall be completed before the temperature of the material cools to less than 200 °F. The material shall be compacted to a density of at least 78 % but not greater than 82 % of the maximum theoretical density as determined by ASTM D2041.

328.8.5.1   Compaction equipment may be steel wheeled, pneumatic wheeled, and hand plate tampers, free of fluid leaks, selected by the CONTRACTOR, and authorized by the ENGINEER. Compaction equipment detected to have leaks shall not be allowed on the project.

328.8.5.2   Compaction may be either static or dynamic (vibratory). All equipment shall be ballasted and operated as recommended by the manufacturer. Motorized wheeled dynamic (vibratory) compaction equipment shall have the frequency rate and amplitude setting readily available for review by the ENGINEER. Frequency rate and amplitude adjustiblility shall be operable on so equipped motorized wheeled dynamic (vibratory) compaction equipment. Motorized compaction equipment with inoperable frequency rate and amplitudeadjustment features shall not be used on the project.

328.8.5.3   Motorized compaction equipment shall be equipped with automatic wheel spray systems to apply release agents to prevent tracking of asphalt concrete. Diesel fuel or other petroleum based solvents shall not be used as a release agent to prevent build up of the asphalt material. Material contaminated with diesel fuel or other

petroleum based solvents shall be removed and replaced with complying material by the CONTRACTOR, as directed by the ENGINEER, at no cost to the OWNER.

328.8.5.4   Repair and replacement of damaged adjacent property and structures, resulting from the use of vibratory rolling equipment, shall be the responsibility of the CONTRACTOR, at no cost to the OWNER.

328.8.6   The surface shall be finished smooth, true to the dimensions shown on the plans, and   be free of any irregularities in excess of 3/16 inch in 10 feet, when tested with a 10 feet long straight edge resting on any two (2) supports of equal height.. Any defective areas shall be immediately corrected removing the defective areas, replacing them with new material to conform to the remainder of the pavement, as directed by the ENGINEER. Such work shall be done by the CONTRACTOR at no cost to the owner.

328.9   SAMPLING AND TESTING

328.9.1.1   A quality assurance asphalt concrete material field sample shall be taken in accordance with the requirements of ASTM D979 for each job mix delivered. The materials shall be sampled at the greater rate of either one sample for each 250 tons, or one sample per day, for each type of material placed on a project, as directed by the ENGINEER. The sample shall be of such size to provide material for all tests specified and a split sample to perform verification/referee tests for gradation and binder content, if required. Tests shall be performed under the direct supervision of a New Mexico Registered Professional Engineer who has completed a certified "SUPERPAVE Mixture Design & Analysis" Short Course, in accordance with the requirements of this Specification the Supplemental Technical Specifications, or as directed by The ENGINEER.

328.9.1.2   Quality assurance asphalt concrete analysis shall be (1) performed in a laboratory accredited in accordance with the requirements of the New Mexico State Highway and Transportation Department "Procedure for Approval of Testing Laboratories to Perform Inspection, Testing, and Mix Design Services", April 13, 1998 Edition, and (2) under the direct supervision of a New Mexico Registered Professional Engineer.

328.9.1.3   Testing equipment used in the performance of specified testing shall be calibrated annually with calibration standards traceable to the national Bureau of Standards. Certification records shall be maintained at the Laboratory for review by The ENGINEER. A copy of the certifications shall be submitted to The ENGINEER upon request.

328.9.2   A sample shall be tested for but not limited to the properties of combined aggregate gradation, asphalt binder content, and maximum theoretical specific gravity/density, and as required in TABLE 328.F.

TABLE 328.F - FIELD SAMPLE LABORATORY TESTS

I.   Analysis (sample aging is not required)
      Analysis at authorized jmf gyrations, N_i (initial), N_d (design), and N_m (max). (1) Two briquettes required. (2) Report average of test results of two briquette tests.

A.   Compaction analysis with authorized design, and specifications (if applicable)

   1   Bulk specific gravity/density, G_{mb}, @ Ni, Nd, and Nm

   2   Maximum theoretical specific gravity/density, Gmm

   3   Compaction: Gmb as % Gmm at Ni, Nd, and Nm

   4   Sample height, mm, at Nd

B.   Volume characteristics of compacted briquettes @ N_d, with design value and specification

   1   VMA, voids in mineral aggregate

   2   Va, voids in asphalt concrete

   3   VFA, voids filled with asphalt binder

II.   Asphalt binder content, with design value and authorized production range

III. Dust ratio with design value and specification

IV.   Extracted Combined Aggregate, with design value(s) and authorized production range

A.   Gradation

B.   Coarse aggregate angularity, material > 4.75 mm, coarse aggregate has two or more fractured faces

C.   Flat and elongated particles, 3:1 or greater dimension, material > 4.75 mm, %

328.9.3   A CONTRACTOR may challenge production material test results, binder content and aggregate gradation, and request that the retained split asphalt concrete sample of record be released to his assigned laboratory and tested for compliance, as authorized by the ENGINEER. Notification of challenge shall be made in writing to the ENGINEER by the CONTRACTOR within 28 calendar days from date of sampling. Challenge test results shall be submitted to the ENGINEER for evaluation no later than 42 calendar days from date of sampling. Challenge test results will be evaluated in accordance with the "multi laboratory" precision tolerances specified, T53 for binder content, ASTM C117 and C136 for aggregate gradation. Challenge and record test results that comply with precision tolerances will be averaged with the companion test results of record and the material pay factor, PF_M, recalculated, as directed by the ENGINEER. Challenge and record test results that do not comply with the precision tolerances will direct the disqualification of the challenged sample, as directed by the ENGINEER. Cut/core sample(s) will be taken from the area(s) represented by the disqualified challenge sample(s) and evaluated by the lab of record under the observation of the CONTRACTOR, in accordance with the requirements of this specification and replace the disqualified sample test results. Analysis of the replacement cut/core sample(s) may not be challenged.   The CONTRACTOR will submit challenge test results in writing to the ENGINEER for each split sample released to his assigned laboratory of record. Challenges filed after the time limitations will not be considered. The OWNER shall pay for all complying tests.

328.9.4.1   Quality assurance in place field compaction tests shall be conducted in accordance with the requirements of this specification, as directed by the Engineer.

328.9.4.2   In place field density shall be measured in accordance with the requirements of ASTM D2950, at the greater rate of either three tests per 500 sy and fraction thereof placed in a day, or three samples per day, as directed by The ENGINEER. Compaction shall be calculated as the bulk specific gravity/density, divided by the average of the maximum theoretical density (G_{MM}) of the samples taken for that day's placement, reported to the nearest one tenth of a percent, xxx.x.%.   The maximum theoretical specific gravity/density (G_{MM}) shall be determined in accordance with ASTM D2041, and reported to the nearest x.xxx / 0.01 pound per cubic foot. The bulk specific gravity (G_{mb}) of a core shall be determined based on the mass (m) measured to the nearest 0.1 g, and the volume (V) calculated to the nearest 0.1 cc. The core volume shall be calculated based on the height (h) and diameter (d) measured to the nearest 0.001 in. The volume shall be calculated using the average

of at least four (4) measurements of the height and diameter, PI=3.1415927, 1 in = 24.4 mm, and the formula V=0.25PId^{2}h. The bulk specific gravity shall be calculated as the mass divided by the volume, G_{mb}=m/V, reported to 0.001. For english units, G_{mb}'=G_{mb}x62.245 pcf. A core shall be drilled with a core barrel having an inside diameter equal or greater than 6 inches.

328.9.4.3   A reference density test of the support material, for the asphalt concrete roadway lift to be construction, shall be taken prior to the placement of the fresh asphalt concrete lift, or defined from previous test results. The density of the support material shall be used as reference in performing the density test of a fresh asphalt concrete lift in accordance with the requirements ASTM

D2950, placed over the support material. A density test of the support material shall be taken at the rate of one (1) test for each 500 sy of surface or less to be paved over in a day, as directed by the Engineer. The density of the support material shall be reported as "reference support material density" in the compaction test report of the constructed asphalt concrete pavement over the area represented by the support material compaction test.

328.9.4.5   Compaction tests shall be taken at random locations, as directed by The ENGINEER. The three (3) general areas in which tests are to be taken are the free edge of a mat, mat interior, and the joints. The number of tests taken in each area will vary but the total number of tests taken on any project shall be in the following ranges.

TABLE 328.G - FIELD IN PLACE DENSITY PROPORTIONS

Location	% of total tests
Free Edge of Mat[1]	20 to 33
Mat Interior	33 to 60
Joints[2]	20 to 33

NOTES:

1 The free Edge of Mat test shall be taken in the area between one (1) foot and two (2) feet in from a free edge of a lift.

2 Joints shall include the longitudinal and transverse butt joints between adjacent lifts of asphalt having the same finish elevation. Tests may be taken on material placed against a cold joint edge of formed surface.

328.9.4.6   Samples of the compacted quiet asphalt concrete pavement shall be sampled by the lab of record and tested to determine compaction at the request of the CONTRACTOR, as directed by the ENGINEER. A minimum of three (3) six (6") inch diameter cores shall be taken at random to represent material placed in a day, at the greater rate of one core for each 250 tons, or fraction thereof, or three cores per day, as directed by the ENGINEER. Compaction shall be calculated as the average measured bulk specific gravity/ density of the core, divided by the average of the maximum theoretical specific gravity/ density (G_{MM}) of the samples taken for that day's placement, reported to the nearest one tenth of a percent, xxx.x.%. The bulk specific gravity (G_{mb}) of a core shall be determined based on the mass (m) measured to the nearest 0.1g, and the volume (V) calculated to the nearest 0.1cc. The core volume shall be calculated based on the height (h) and diameter (d) measured to the nearest 0.001 in. The volume shall be calculated using the average of at least four (4) measurements of the height and diameter, PI=3.1415927, 1 in = 24.4 mm, and the formula V=0.25PId^{2}h. The bulk specific gravity shall be calculated as the mass divided by the volume, G_{mb}=m/V, reported to 0.001. For english units, G_{mb}'=G_{mb}x62.245 pcf. A core shall be drilled with a core barrel having an inside diameter equal or greater than 6 inches. The maximum theoretical specific gravity/density (G_{MM}) shall be determined in accordance with ASTM

D2041, and reported to the nearest one-thousandth (0.001) and one-tenth pound per cubic foot. Compaction determined from cores shall supersede tests results determined under ASTM D2950. The CONTRACTOR shall be responsible for asphalt concrete material replacement at cores holes, at no cost to the OWNER, where samples are removed. The OWNER shall pay for all complying quality assurance compaction sampling and tests.

328.9.4.7   Full depth cores the shall be taken, as directed by the Engineer, to determine the depth of structure and determine the depth pay factor, PF_D, defined in TABLE 328.J. A minimum of three full depth cores, having a minimum outside diameter of four (4) inches, shall be taken at random for each 1000 sy, or fraction thereof placed. Cores shall be evaluated in accordance with the requirements of 328.9.7. The core length, depth of the pavement, shall be determined based on the average of three measurements of the length of the core, measured from circular ends of a sample. All measurements shall reported to the nearest 0.125" (1/8 inch).

328.9.5.1   Test reports shall include but not be limited to the information specified in   TABLE 328.H - TEST REPORT.

328.9.5.2 Test results shall be reported to The ENGINEER, CONTRACTOR, Supplier and Materials and Testing Laboratory, Construction Division, Public Works Department, in writing, within 7 working days of completion of the sampling of the asphalt and/or the field testing. Non-complying tests shall be reported to The ENGINEER, CONTRACTOR, supplier and Materials and Testing Laboratory, Construction Division, Public Works Department, within 1 working day of completion of the test.

328.9.5.3 The New Mexico Registered Professional Engineer in direct charge of the laboratory shall certify on a quality assurance test report that the test procedures used to generate the report complied with the specifications

TABLE 328.H TEST REPORT

A.		Field Data and Test Results:
	1	Date of Sampling/Test
	2	City of Albuquerque Project Number or Permit Number
	3	Project Title
	4	Asphalt Concrete Supplier
	5	Delivery Ticket Number (asphalt concrete sample-only)
	6	Job Mix Formula Number
	7	Location of sample/test as defined by Contract Documents
	8	LOT/SUBLOT reference, as directed by the ENGINEER
	9	Time of field sampling/testing
	10	Material temperature at time of sampling, °F
B.		Laboratory Test Results
	1	Laboratory results as defined in TABLE 328.F
	2	Field test results with reference specification limits for each LOT
C.		Recommended Pay Adjustment Factor for a LOT
	1	C_{LM}, material factor, see TABLE 328.H
	2	C_{LC}, placement/compaction factor, see TABLE 328.I
	3	PF_D, depth factor defined in TABLE 336.F, see 328.J

328.10 MEASUREMENT AND PAYMENT:

328.10.1 Quiet asphalt concrete shall be measured by the square yard/lift, material delivered , placed, compacted, and finished at the project, as specified in the CONTRACT DOCUMENTS. It shall be measured in a LOT, as directed by the ENGINEER. A LOT shall be each 1000 square yard/lift, or fraction thereof, or as specified in the supplemental technical specifications. Quality assurance materials sampling and testing for a LOT shall be taken for each sublot of 250 tons placed, or fraction thereof, as directed by the Engineer. Compaction testing shall be taken for each sublot of 500 sy in accordance with this Section.

328.10.2 Quiet asphalt concrete pavement shall be paid at the adjusted CONTRACT unit price, adjusted for payment by the equation below, as authorized by the ENGINEER.

328.10.3.1 Quiet asphalt concrete pavement placed in an area of 10 feet or more in width and 100 feet or more in length (requiring machine lay down) shall be divided into LOTS and paid at the adjusted CONTRACT unit price, specified in this section, as authorized by the ENGINEER.

328.10.3.2 Quiet asphalt concrete pavement placed in an irregular area complying with 328.7.2 shall be divided into LOTS and paid at the adjusted CONTRACT unit price, specified in this section, as authorized by the ENGINEER.

328.10.4.1 A LOT shall be paid at a unit price equal to the sum of the adjusted CONTRACT unit price, adjusted for deviation of full depth of structure from CONTRACT specification. The unit price for a LOT shall be calculated in accordance with the equation below.

$$UP' = PF_D \times F_N \times UP$$

F_N, $0.5 \times (C_{LM} + C_{LC})$, LOT adjustment factor
C_{LM}, material factor, see TABLE 328.H
C_{LC}, placement/compaction factor, see TABLE 328.I
PF_D, depth factor defined in TABLE 328.J
UP, CONTRACT unit price

328.10.4.2 The material factor, C_{LM}, is the material

acceptance factor for a LOT determined in accordance with TABLE 328.H, based on the absolute value of the deviation of the average value, or arithmetic mean (M), of the daily acceptance sample(s) test results of the sublots for the LOT, deviation from the CONTRACT authorized job mix formula targets (T), for either combined aggregate gradation or binder content. Acceptance samples shall be sampled and tested in accordance with the requirements of this specification.

328.10.4.3   If the deviation is equal or less than the allowable deviation, D', the corresponding material pay factor, C_{LM}, shall be used.

TABLE 328.H MATERIAL FACTOR, C_{LM}, FOR GRADATION & ASPHALT BINDER CONTENT

Number of Daily Samples	D', Maximum Allowable Deviation [1, 2, 3]		
1	1.40D	1.20D	D
2	D + R	D + 0.37R	D - 0.10R
3	D + 0.30R	D + 0.07R	D - 0.14R
4	D + 0.16R	D - 0.01R	D - 0.17R
5	D + 0.11R	D - 0.03R	D - 0.20R
6	D + 0.09R	D - 0.05R	D - 0.22R
7	D + 0.07R	D - 0.07R	D - 0.24R
8	D + 0.06R	D - 0.08R	D - 0.25R
9	D + 0.05R	D - 0.09R	D - 0.26R
10 or more	D + 0.04R	D - 0.10R	D - 0.27R
Material Factor, C_{LM} [3]	0.85	0.95	1.00

[1] D, production tolerance ± %, specified in the authorized job mix formula;
   R, range of test values, maximum - minimum values; M, average test value of a LOT's acceptance samples test results;
   T, target value specified in authorized job mix formula.
[2] The material factor, C_{LM}, shall be the lowest factor selected for $|T-M| \leq D'$ calculated for either (a) the combined aggregate gradation and material passing the nominal maximum size aggregate screen, 3/8 inch (9.5 mm), and smaller screens of the project authorized job mix formula, or (b) the asphalt binder content.
[3] If the absolute value of the deviation of the daily mean from the target exceeds the maximum allowable deviation for a LOT, $|T-M| \geq D'$, the LOT shall be removed and replaced with material complying with this specification, at no cost to the OWNER, as directed by the ENGINEER. If it is determined by the ENGINEER to be more practical to accept the LOT material, it may be accepted under written agreement between the OWNER and the CONTRACTOR, at an assigned pay factor, $C_{LM} = 0.70$, for a LOT having a compaction factor, $C_{LC} \geq 0.85$, as directed by the ENGINEER.

328.10.5   The LOT placement/compaction factor, C_{LC}, shall be defined in accordance with TABLE 328.I, as directed by the ENGINEER. The factor is determined based on the average of the compaction tests taken for a LOT, with no single test neither less than 77.0 % nor greater than 84.0 %. Acceptance compaction tests shall be performed in accordance with the requirements of this specification. A LOT having a average compaction either less than 77.0 % or greater than 84.0 % shall be evaluated, as directed by the ENGINEER.

TABLE 328.I - PLACEMENT/COMPACTION FACTOR, C_{LC}

Average Test Results	Factor, C_{LC}
84.1 % and greater	[1]
83.1 to 84.0	0.85
82.1 to 83.0	0.90

78.0 to 82.0	1.00
77.0 to 77.9	0.85
less than 77.0%	[1]

[1] The lift defined for the LOT shall be removed and replaced by the CONTRACTOR with asphalt concrete pavement complying with this specification at no cost to The OWNER, as directed by the ENGINEER. If it is determined by the ENGINEER to be more practical to accept the LOT, it may be accepted under written agreement between the OWNER and the CONTRACTOR at an assigned compaction pay factor, $C_{LF} = 0.50$, for the LOT, if the LOT has a material pay factor, $C_{lm} \geq 0.85$, as authorized by the ENGINEER.

328.10.6   The depth factor, PF_D, shall be defined in accordance with TABLE 328.J, based on the layer thickness of quiet asphalt concrete measured from cut samples taken from full depth cores of the construction pavement section taken at random in accordance with 328.9.4.7. The pay factor PF_D shall be determined based on the deviation of the average layer thickness (d_A) from the specified lift thickness (D_S), of a minimum of three (3) wafers cut from full depth cores. The average thickness of the wafers shall be measured to the nearest 0.125 (1/8) in. The thickness of any single wafer shall not be less than the specified section depth, minus 0.25 in. If an individual wafer thickness is identified with a thickness less than the specified depth, minus 0.25 in, additional cores may be taken to verify the condition, as directed by the ENGINEER. If the deficient condition is verified for a LOT, the depth deficient quiet asphalt concrete pavement shall be removed and replaced with complying pavement by the CONTRACTOR at no cost to the OWNER, as directed by the ENGINEER. Cores and cut wafers shall be maintained at the laboratory for a period of four weeks from date of sampling for review by the CONTRACTOR.

TABLE 328.J DEPTH FACTOR, PF_D

Deficient Pavement Depth					PF_D
0.00 in	$\leq$	$D_S - d_A$		0.25 in	1.00
0.25 in	$<$	$D_S - d_A$	$\leq$	0.50 in	$(d)^2/(D)^2$
		$D_S - d_A$	$>$	0.50 in	[A], [B]
Excessive Pavement Depth, d-D					PF_D
		$D_S - d_A$	$<$	0	1.00

NOTES:

D_S specified depth for the pavement structure of a Lot.

d_A average depth of the pavement structure as determined in accordance with 338.8.4.7

[A]   CONTRACTOR shall correct deficiencies, constructing the pavement to the depth, grade, crown, and cross slope drainage, specified in the CONTRACT documents, at no cost to the OWNER, as directed by the ENGINEER.

[B]   If determined by the ENGINEER to be more practical to accept the pavement, the LOT may be accepted under written agreement between the OWNER and the CONTRACTOR, at an assigned pay factor of PF_D = $(d)^2/(D)^2$, for LOT(s) , as authorized by the ENGINEER.